A PLIOCENE FLAMINGO FROM MEXICO

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FIELD parties from the California Institute of Technology have been fortunate in locating a variety of fossil deposits in Mexico that included bird remains. Some have been very rich in the quantity and variety of material; for example, the San Josecito Cavern of Nuevo León (Miller, 1943), a deposit of Pleistocene age, yielded several thousand bird bones assigned to over forty species. The present paper deals with a collection of ten fragments, all but one of which are included in a single species. I am indebted to Dr. Chester Stock in charge of the explorations for the opportunity of working with the bird collections. Dr. Alexander Wetmore has loaned comparative material, and Dr. Hildegarde Howard has been a most congenial fellow student during many conferences on the flamingoes, both Recent and Fossil. To these several colleagues my sincere thanks are offered.

The ten fragments are from collecting locality No. 289, California Institute of Technology, known as the Rincón Pliocene, Chihuahua, Mexico. Associated mammal remains include horse, camel, antelope, and carnivore species. The matrix is a fine grained silt of lightest color, without cementing material. A stiff brush serves to remove it from the well petrified bones. Unfortunately the specimens are most fragmentary. They do, however, prove to be of interest in several respects; most notably they prove (since several speciments are from pre-volant young) that a small species of flamingo was present as a breeding bird. This is the earliest record for the family in America. Flamingoes are recorded from the Upper Oligocene of France (Milne-Edwards, 1868:53), but the earliest previous record from the New World is from the Pleistocene of Oregon (Shufeldt, 1892:410).

Phoenicopterus stocki, new species

Stock's Flamingo

Type specimen $\frac{289}{3245}$, California Institute of Technology, tibiotarsus (distal end) from the Rincón Pliocene of Chihuahua, Mexico. The species has the morphological characters of the genus but is of pigmy size. (See Figure 1.)

From the same locality, there were retrieved several other fragments that are here assigned to the one species. The proximal end of a tibia may have come even from the same individual, though from the opposite side. This specimen shows certain characters that are distinctive and, were the conspecific identity of the fragments more completely assured, these osteological characters could be added to the description of

the species. There is less backward extension of the inner articular facet as compared with *Phoenicopterus ruber* and *P. chilensis,* the postero-axial border of this facet (*F,* Figure 2) is more nearly an arc of a true circle, and the posterior notch (*E,* Figure 2) is shallower. In these characters the Pliocene bird approaches the Old World species, *Phoenicopterus antiquorum,* more closely than it does either *P. ruber* or *P. chilensis* from the New World. No skeletons of the genus *Phoenicoparrus* were available for comparison, but skins of the two species of

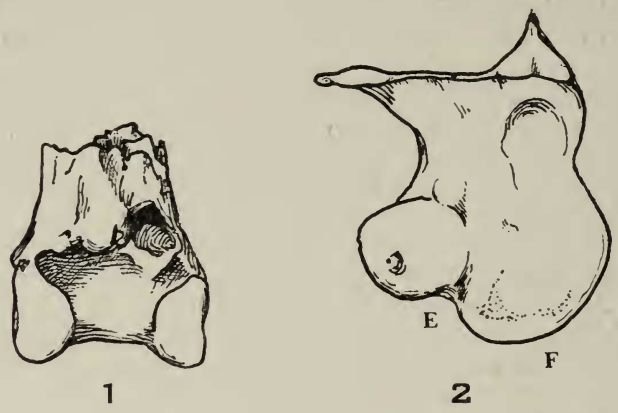

Figure 1. *Phoenicopterus stocki.* Type specimen. Tibiotarsus (distal end). Twice natural size.

Figure 2. *Phoenicopterus stocki.* Tibial head assigned to the same species as the type. Twice natural size. *E,* posterior notch; *F,* postero-axial border. Drawings by Gretchen L. Burleson.

that genus show them to be larger than the Pliocene bird. The generic characters of *Phoenicoparrus* seem to be displayed mainly in the peculiarly heavy beak with its prominent and horizontal lamellae. Whether osteological characters of the tibiotarsus are distinctive is not known. It was considered wiser, therefore, to place the fossil species in the typical genus of the family.

In making this study, certain characters of the limb bones of flamingoes (Table 1) were uncovered which might be of value to later students of the genus *Phoenicopterus.* Peters (1931:141) recognizes no geographic races in any of the species despite their wide and sometimes interrupted ranges, and homogeneity is evident in such skeletons as could be assembled. In the series of Old World birds, *Phoenicopterus antiquorum* (=*roseus*); four specimens were taken in India and one in Egypt. All are of the same sex, but there is greater size variation among those from India than appears between the Indian and the Egyptian birds. Two specimens of *P. chilensis* (♂, ♀) were examined. Both,

TABLE 1

MEASUREMENTS OF VARIOUS FLAMINGOES' LEG BONES

		Length	Width of head	Width of distal end	Sagittal diameter condyles	Width of shaft	
P. chilensis[1]	♂	298 mm.	17.7 mm.	15.4 mm.	17.5 mm.	7.1 mm.	Tibiotarsus
P. chilensis[2]	♀	273	17.2	15.7	17.6	7.2	
P. ruber[3]		307	16.6	14.0	17.6	6.9	
P. antiquorum[4]	♀	392	20.7	17.8	20.4	8.4	
P. antiquorum[5]	♀	358	21.2	17.7	20.3	7.5	
P. antiquorum[6]	♀	351	19.7	17.4	20.0	8.2	
P. antiquorum[7]	♀	358	19.5	17.2	20.2	7.8	
P. chilensis[1]	♂	290	18.5	18.5		5.4	Tarsometatarsus
P. chilensis[2]	♀	251	18.1	19.7		5.6	
P. ruber[3]		287	16.9	17.9		5.7	
P. antiquorum[4]	♀	378	20.5	20.7		6.3	
P. antiquorum[5]	♀	334	20.2	20.8		6.0	
P. antiquorum[6]	♀	352	21.0	19.6		6.7	
P. antiquorum[7]	♀	346	20.0	19.4		6.5	

1, *U. S. Nat. Mus. 344,931.* 2, *U. S. Nat. Mus. 344,932.* 3, *Los Angeles Mus. Bi-1,295.* 4, *Univ. Calif. at Los Angeles 1,786.* 5, *Univ. Calif. at Los Angeles, 1750.* 6, *Univ. Calif. at Los Angeles 1,785.* 7, *Univ. Calif. at Los Angeles 265.*

seemingly, were mature birds, but the male had longer and more slender tibia and tarsus and a smaller foot than the female. These variations are not such as commonly depend upon age, and they are probably not sexual, but individual, differences.

An interesting character is seen in the form of the intercotylar knob at the proximal end of the tarsus. In *Phoenicopterus chilensis* this knob is very broad and rounded; in *P. ruber* it is much narrower and more pointed; in *P. antiquorum* it is intermediate but approximates that of the Chilean bird. Unfortunately the intercotylar knob is not represented in the Pliocene collections.

TABLE 2

TIBIAL CONDYLES IN PHOENICOPTERUS

		Transverse diameter	Sagittal diameter	Ratio
P. ruber[3]		14.0 mm.	17.6 mm.	.78
P. ruber[8]		14.0	17.8	.78
P. chilensis[1]	♂	15.4	17.5	.83
P. chilensis[2]	♀	15.7	17.6	.83
P. antiquorum[4]	♀	17.8	20.4	.87
P. antiquorum[5]	♀	17.7	20.3	.87
P. antiquorum[6]	♀	17.4	20.0	.87
P. antiquorum[7]	♀	17.2	20.2	.87
P. copei[9]		17.0	20.0	.80
P. stocki[10]		12.9	16.2	.798

8, *Univ. Calif. at Los Angeles 1,981.* 9, *Amer. Mus. Nat. Hist. 3,485.* 10, *Calif. Inst. Tech. 3,245.* 1 to 7 as in Table 1.

In a study of the distal articulation of the tibia another interesting character is uncovered by taking the ratio of maximum transverse diameter to maximum sagittal diameter. This ratio (Table 2) is least in *Phoenicopterus ruber* (78 per cent) followed in order by *P. stocki* (79.9 per cent), *P. copei* (80.5 per cent), *P. chilensis* (83 per cent) and *P. antiquorum* (87 per cent).

Two distal fragments of the humerus were collected at the Rincón locality. Both are from the left wing, and they differ markedly in size; the larger is almost equal to *Phoenicopterus chilensis,* and the other is smaller than any living species of which the skeleton is available. The question naturally arises as to their specific identity. There appears to be a great variability in size of wing relative to leg bones in the flamingoes. In two specimens of *P. chilensis* from the same source, the male has the longer but the narrower tibia. The humerus is, however, both longer and thicker. A similar high degree of variability is seen among several specimens of *P. antiquorum* of the same sex, date, and source.

In view of this variability among Recent birds it seems justifiable to allocate all the Pliocene material to a single species although the possibility of error must be conceded. There might possibly have been two species of flamingo resorting to the same lagoon just as today we may have several species of heron feeding in the same marsh or breeding in the same heronry. Akeley (1924:128) found two species of flamingo of different genera in the same flock at Lake Hannington in northern Africa.

As stated above, the only other fossil flamingo recorded from the Western Hemisphere is *Phoenicopterus copei* of the Oregon Pleistocene, a bird which Shufeldt (1892:410) considered to be "longer winged and longer legged and toed than *P. ruber.*" It inhabited a terrain that was probably not greatly different from the preferred niche of the living species of the genus, namely an open body of water with extensive mud bars from which the truncated nest-cones can be easily piled up or added to without much change of stance on the part of the builder. From this shallow mud pan the food of the flamingo is sifted by the peculiarly constructed beak held in the "topsy-turvy" position to which the birds have been structurally adapted at least since Oligocene time. It seems justifiable then to conclude that the Pliocene bird had the same habit and that the presence of pre-volant young accentuates the picture of shallow lagoon and mud flat.

Furthermore the birds seem to have a strong predilection for waters of a fair degree of salinity. The African bird is especially abundant about the bitter waters of the African plateau country. *P. ruber* is partial to those "half islands" in the Caribbean area, where water and mud are scarcely differentiated, and to the saline crater lakes of the Galápagos Islands. The Chilean bird finds in the semi-desert of Argentina, Chile, and Patagonia the same salt-pan environment (Hudson, 1920:

127). Is it not justifiable therefore to postulate a comparable environment in Pliocene time at the Rincón locality of Chihuahua?

The very word flamingo brings to the mind of an American ornithologist the thought of tropical regions, and unless he turns his attention to species other than the familiar *P. ruber* and *P. antiquorum* his judgment of the value that fossil flamingoes hold as climatic indices may be somewhat distorted. Hudson (p. 129) says that he "spent half a winter in Patagonia at a house built on the borders of a small lake, and regularly every night a small flock of Flamingoes came to feed in the water about 200 yards from the back of the house." These birds did not migrate to the milder latitudes in winter although Hudson had the impression that others of the same species that were reared at higher altitudes or farther from the coast did move to the northward in autumn. The Pleistocene flamingo from Oregon and this Pliocene species of Chihuahua do not necessarily indicate, therefore, a warmer nor yet a damper climate during those earlier epochs. They do, however, indicate a local ecologic niche that has disappeared.

A genus of birds that had reached the high degree of specialization seen in *Phoenicopterus* at a time as early as Oligocene (Milne-Edwards, 1868:53), when the horses were but the half-horses of *Mesohippus* stage, might be expected to have almost run their earthly course by Recent time. Perhaps it is not so strange that North America has more fossil flamingoes than there are represented in our living fauna.

Discussion

The New World has four living species of flamingoes belonging to two genera. Two species of the genus *Phoenicoparrus* are of restricted range and reduced numbers. The other genus, *Phoenicopterus,* has a wide range, with some striking interruptions in the specific range of *P. ruber.* The Old World likewise has two flamingo genera but with only two species. One of these (*Phoeniconaias*) again is more restricted in range, the other is wide ranging. None of the species is divisible into geographic races.

A first impression produced by this picture might be that the flamingoes had arisen as a New World group. But on the one hand, the Oligocene of Europe yielded to Milne-Edwards (1868:53) a fairly abundant fauna of phoenicopterid birds, including the typical genus as well as some less specialized in beak structure (Lambrecht, 1933:344). The number of individuals also is not insignificant. We get therefore an impression that the family was of considerable importance in the Oligocene avifauna. (Their subsequent withdrawal to the southward and the dropping out of many species follows a pattern that is not unlike those of some of the ordinal groups of mammals that are now better represented farther to the south, even in ultra-tropical latitudes.)

On the other hand we find no record for flamingoes in the New

World until much later. For fifty years the literature of American paleontology has held but one record, *Phoenicopterus copei* Shufeldt of the Oregon Pleistocene. The present paper furnishes the second record and takes the family back only to Pliocene time. The extensive Tertiary mammal beds of both North and South America are entirely lacking in flamingo remains. It seems hardly probable, then, that birds so gregarious as these could have held a place here comparable in importance with their position in the Old World. The phororhacid birds left such an extensive record in the South American Tertiaries that the flamingoes might properly have left a comparable record had they been present as a vigorous, evolving family. My own impression is that the family is a relatively late arrival in the Americas, where it has undergone minor differentiation and has survived with a greater number of living species than in its ancestral home, Eurasia.

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